Supplementary Table 1. Definition of each independent variable included in risk factors analysis for carbapenemase-producing organisms (CPO) infection and colonisation

| **Variables** | **Definition** |
| --- | --- |
| ***Demographics*** | *According to General Acute Inpatient and Day Case-Scottish Morbidity Record (SMR01) 1* |
| Age, years | Age at diagnosis |
| Age>60 years old | Age over 40 years old |
| Gender, male | As described in medical records |
| ***Comorbidities*** | *According to International Classification of Diseases-10th Revision codes (ICD-10) 2* |
| Neoplasms and diseases of the blood and blood-forming organs | C00-D89 2 |
| Malignancy | C00-C80, C7A, C81-C96, D00-D09 2 |
| Solid | Including carcinoma and malignant neoplasm |
| Hematology | Including lymphoma, leukaemia, multiple myeloma and myelodysplastic syndrome |
| Anaemia | Neoplasms and diseases of the blood and blood-forming organs with anaemia |
| Endocrine, nutritional and metabolic diseases | E00-E89 2 |
| Diabetes mellitus | Including Type 1 and Type 2 |
| With complications | Including circulatory complications, ketoacidosis and multiple complications |
| Diseases of the circulatory system | I00-I99 2 |
| Heart failure | Circulatory diseases with heart failure |
| Diseases of the respiratory system | J00-J99 2 |
| Respiratory failure | Circulatory diseases with respiratory failure |
| Diseases of the digestive system | K00-K95 2, excluding constipation |
| Diseases of the genitourinary system | N00-N99 2 |
| Renal failure | Diseases of the genitourinary system with renal failure or chronic kidney disease at stage 5 |
| Diseases of the nervous system | G00-G99 2 |
| Diseases of the skin and subcutaneous tissue | L00-L99 2 |
| Diseases of the musculoskeletal system and connective tissue | M00-M99 2 |
| External causes of morbidity | V00-Y99 2 |
| Injury, poisoning and certain other consequences of external causes | S00-T88 2 |
| Immunocompromised status | Patients with AIDS, malignancy, stem blood cell or organ transplant, chemotherapy or radiotherapy |
| ***Healthcare exposure*** | *According to General Acute Inpatient and Day Case-Scottish Morbidity Record (SMR01) 1, healthcare exposure in the prior 90 days before specimen collection date of the first positive culture for cases and non-CPO controls, before the discharge date of the index hospitalisation for general inpatient controls, unless stated otherwise.* |
| Emergency admission | For the index hospitalisation, Admission Type: 30-39 1 |
| Admission from healthcare facilities | For the index hospitalisation, Admission/Transfer From: 24, 25, 40-59, 4A-4H, 5A-5H 1 |
| Surgical Specialty | For the index hospitalisation, Specialty/Discipline: C1, C3, C6, C8, C9, C11-13, C41-42, CA, CB 1 |
| TAR, days | For the index hospitalisation, interval between hospital admission and specimen collection date of the first positive culture |
| HDU stay | Stayed in HDU |
| Duration of HDU stay, days | Total days of HDU stay |
| ICU stay | Stayed in ICU |
| Duration of ICU stay, days | Total days of ICU stay |
| Hospitalisation | Admitted to a hospital *in the prior 90 days before the current index admission date* |
| Duration of hospitalisation, days | Total days of hospital stay |
| Hospital transfer | Transferred between different hospitals |
| Ward transfer | Transferred between different significant facilities during hospitalisation |
| ***Invasive procedures*** | *According to OPCS Classification of Interventions and Procedures version 4.7 (OPCS-4.7) 3, procedures conducted in the prior 90 days before specimen collection date of the first positive culture for cases and non-CPO controls, before the discharge date of the index hospitalisation for general inpatient controls.* |
| Any | Any invasive procedures mentioned below |
| Transplantation | Stem blood cell or solid organ transplantation |
| Centesis | Extraction of bone marrow, spinal puncture, pleural aspiration or percutaneous needle biopsy |
| Ectomy | Ectomy, excision, resection, amputation or extirpation surgical operation |
| Catheterisation | Insertion of indwelling devices, including tunnelled catheter, urinary catheter, CVC and percutaneous transluminal cannulation of artery |
| Urinary catheter | Insertion of urinary catheter |
| CVC | Insertion of CVC |
| Dialysis or drainage | Dialysis or drainage requiring catheterisation, including haemodialysis, peritoneal dialysis, drainage of ascites/ventricle of brain/sphenoid sinus/gall bladder/pleural cavity/biliary/cerebrospinal fluid |
| Endoscopic operation | Endoscopic examination, resection, cauterization, insertion, dilation, aspiration, incision or extirpation |
| Invasive ventilation | Invasive ventilation |
| Other surgical procedures | Xenograft replacement, autograft of skin, vein graft, debridement, prosthetic replacement, repair of diaphragmatic hernia, drainage of perianal abscess/lesion of skin, opening of abdomen, posterior instrumented fusion of lumbar spine, open reduction of fracture, internal fixation, ileostomy, tracheostomy, percutaneous insertion of nephrostomy tube, cystostomy, gastrostomy, antrostomy, intubation of stomach, arteriography, stomach bypass, aorta anastomosis, percutaneous transluminal angioplasty, colostomy, evacuation of subdural haematoma, freeing of adhesions of peritoneum, annuloplasty, colporrhaphy, implantation of cardiac pacemaker system, transluminal operations on coronary artery |

CPO, Carbapenemase-producing organisms; ICU, intensive care unit; HDU, high dependency unit; TAR, time at risk; CVC, central venous catheter.

Supplementary Table 2. Distribution of cases and controls and care level of each hospital

| **Hospital** | **Care level** | **Number of cases** | **Number of general inpatient controls** | **Number of non-CPO controls** |
| --- | --- | --- | --- | --- |
| 1 | Tertiary care | 20 | 60 | 35 |
| 2 | Tertiary care | 13 | 39 | 25 |
| 3 | Tertiary care | 11 | 33 | 15 |
| 4 | Tertiary care | 6 | 18 | 14 |
| 5 | Tertiary care | 5 | 15 | 9 |
| 6 | Tertiary care | 5 | 15 | 5 |
| 7 | Tertiary care | 2 | 6 | 4 |
| 8 | Tertiary care | 2 | 6 | 2 |
| 9 | Tertiary care | 1 | 3 | 3 |
| 10 | Tertiary care | 1 | 3 | 3 |
| 11 | Tertiary care | 1 | 3 | 3 |
| 12 | Secondary care | 14 | 42 | 21 |
| 13 | Secondary care | 7 | 21 | 10 |
| 14 | Secondary care | 5 | 15 | 14 |
| 15 | Secondary care | 3 | 9 | 5 |
| 16 | Secondary care | 2 | 6 | 5 |
| 17 | Secondary care | 2 | 6 | 1 |
| 18 | Secondary care | 1 | 3 | 3 |
| 19 | Secondary care | 1 | 3 | 2 |
| 20 | Secondary care | 1 | 3 | 1 |
| 21 | Secondary care | 1 | 3 | 1 |
| Total | | 104 | 312 | 181 |

Supplementary Table 3. Comparison of mortality rates between 56 CPO infection cases and 121 non-CPO infection controls by infection type

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Infection type** | **All-cause 30-day mortality rate** | | | **All cause 1-year mortality rate** | | |
| **CPO**Ф | **Non-CPO**Ф | ***P***§ | **CPO**Ф | **Non-CPO**Ф | ***P***§ |
| Urinary tract infection | 2/15 | 1/25 | 0.545 | 6/15 | 5/25 | 0.273 |
| Bloodstream infection | 4/16 | 10/48 | 0.736 | 9/16 | 20/48 | 0.469¶ |
| Respiratory tract infection | 3/9 | 2/15 | 0.326 | 3/9 | 4/15 | 1.000 |
| Wound infection | 0/7 | 2/12 | 0.509 | 4/7 | 4/12 | 0.378 |
| Gastrointestinal infection | 0/5 | 1/11 | 1.000 | 1/5 | 2/11 | 1.000 |
| Bacterial meningitis | 1/3 | 1/9 | 0.455 | 1/3 | 2/9 | 1.000 |
| Skin and soft tissue infection | 0/1 | 0/1 | 1.000 | 0/1 | 0/1 | 1.000 |

CPO, carbapenemase-producing organisms; non-CPO, organisms that do not yield carbapenemases.

Ф, number of deaths/total number of CPO cases or non-CPO controls by infection type;

§, Fisher’s exact test, unless stated otherwise;

¶, Pearson’s Chi-squared test.

Supplementary Figure 1. Forest plots of results of univariate analyses of risk factors for carbapenemase-producing organisms (CPO) infection by comparing cases and non-CPO controls/general inpatient controls. (A) Demographics and comorbidities related variables; (B) Healthcare exposure and invasive procedures related variables.

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HDU, high dependency unit; ICU, intensive care unit.

Supplementary Figure 2. Forest plots of results of univariate analyses of risk factors for carbapenemase-producing organisms (CPO) colonisation by comparing cases and non-CPO controls/general inpatient controls. (A) Demographics and comorbidities related variables; (B) Healthcare exposure and invasive procedures related variables.

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**(A)**

Chart, line chart

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**(B)**

HDU, high dependency unit; ICU, intensive care unit.

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2. Centers for Disease Control and Prevention. International Classification of Diseases-10th Revision codes. 2017. <https://www.cdc.gov/nchs/icd/icd10cm.htm>.

3. National Health Service Digital. OPCS Classification of Interventions and Procedures version 4.7. 2017. <https://digital.nhs.uk/data-and-information/information-standards/information-standards-and-data-collections-including-extractions/publications-and-notifications/standards-and-collections/scci0084-opcs-classification-of-interventions-and-procedures>.